Chapter VI

Conclusions and Recommendations

The objective of this research was to study the preparation of three-way catalysts which exhibited the highest efficiency for the removal of three pollutants in exhaust gases. The results obtained from this research can be summarized as follows :

1. The importance of cerium as the promoter in three-way catalyst was that it could enhance the catalyst activity and reduce inhibition effect to CO-oxidation at high temperature.

2. The improvement by cerium addition could be made up to 9%wt of Ce content.

3. If too much amounts of cerium were added, the activity of catalyst was reduced.

4. The ratio of Pt-to-Rh affected the catalytic efficiency. The catalytic performance decreased when the ratio of Pt-to-Rh increased. The suitable ratio of Pt-to-Rh was 3:1.

5. The loading order of catalyst was also important. The best conventional catalyst should be prepared by the following procedure.

(i) load 9%wt of cerium and then calcined in air at 500 °C for 4 h.

(ii) Re-impregnated the catalyst obtained from (i) with Rh using 0.01%wt of rhodium nitrate solution and then calcined in air at 500 °C for 4 h.

(iii) Finally, impregnated with Pt using 0.03%wt of chloroplatinic acid solution and then calcined with the same condition as in step (ii).

6. The SMSI effect could be induced by calcination in reducing atmosphere at a high temperature.

7. The SMSI phenomena gave the beneficial effect to the three-way catalytic activity. The best catalyst was the modified catalyst in 10%N_2 + H_2 atmosphere at 700 °C for 7 h.

8. The modified catalyst could improve the catalytic efficiency as follows :

CO conversion was enhanced by 30 percent

C_3H_8 conversion was enhanced by 20 percent

and NO conversion was enhanced by 20 percent.

9. The modified three-way catalyst was as durable as the conventional catalyst ; however, the modified catalyst had slightly higher activity.

10. The catalytic performance was affected by oxygen concentration.

11. The modified catalyst prepared by calcination in reducing atmosphere could enlarge the window from 1 $\pm$ 0.02 to 1 $\pm$ 0.03.

12 . The modified catalyst could be further improved by calcination in simulated exhaust gas (rich condition : S<1). The catalyst pretreatment should be made under this atmosphere in a high temperature (700 °C) for about 7 hours.

13. The condition of pretreatment may induce the SMSI effect. Futhermore, this effect could enhance much more efficiency than the modified catalyst . The enhancements of efficiency were

CO conversion was enhanced by 33 percent

C_3H_8 conversion was enhanced by 30 percent

and NO conversion was enhanced by 30 percent.

From this research, the recommendations for further study are as follows:

1. There are some obvious disadvantages in the use of noble metals Pt, Rh and Pd catalyst. They are relatively very scarce and therefore very expensive. The other transition metals should be investigated to be used in automotive emission control reaction.

2. Attempts to extend the modified catalyst efficiency to the other hydrocarbon compounds e.g. propylene, butane, ethylene etc should be studied.

3. A research should be carried out to be able to scale up the modified catalyst in order to be used in practice.